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USING DIAGNOSIS RELATED GROUPS (DRGS) TO MONITOR
CONVALESCENT LEAVE(U) NAVAL SCHOOL OF HEALTH SCIENCES
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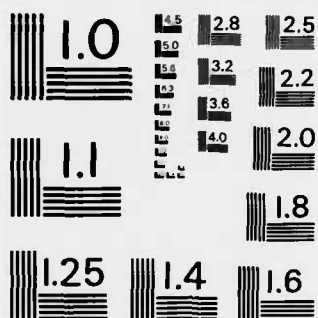
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USING DIAGNOSIS RELATED GROUPS (DRGs) TO MONITOR CONVALESCENT LEAVE

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Research Paper 2-83
October 1983

by Terrence L. Kay
Karen A. Rieder

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REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM	
1. REPORT NUMBER Naval School of Health Sciences Bethesda, MD, Research Dept #2-83	2. GOVT ACCESSION NO. AD-A148437	3. RECIPIENT'S CATALOG NUMBER	
4. TITLE (and Subtitle) Using Diagnosis Related Groups (DRGs) to Monitor Convalescent Leave		5. TYPE OF REPORT & PERIOD COVERED October 82-October 83	
		6. PERFORMING ORG. REPORT NUMBER	
7. AUTHOR(s) Terrence L. Kay Karen A. Rieder, CDR, NC, USN		8. CONTRACT OR GRANT NUMBER(s)	
9. PERFORMING ORGANIZATION NAME AND ADDRESS Naval School of Health Sciences Bethesda, Maryland 20814		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS 65152N M106-PN.001-0005	
11. CONTROLLING OFFICE NAME AND ADDRESS Naval Medical Research and Development Command Naval Medical Command, National Capital Region Bethesda, Maryland 20814		12. REPORT DATE December 1983	
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)		13. NUMBER OF PAGES	
		15. SECURITY CLASS. (of this report) 	
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE	
16. DISTRIBUTION STATEMENT (of this Report) Approved for public release: distribution unlimited			
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)			
18. SUPPLEMENTARY NOTES			
19. KEY WORDS (Continue on reverse side if necessary and identify by block number) Convalescent leave Hospital performance Diagnosis Related Groups (DRGs) Productivity Case Mix			
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) A primary responsibility of the Navy Medical Department is to ensure that active duty Navy and Marine Corps personnel who have experienced disease and injury are returned to duty as soon as medically indicated. One major contributor to lost work time among active duty personnel is convalescent leave, which is a period of medically ordered convalescence following hospitalization. Recommendations for convalescent leave that are not medically justifiable can have a serious impact on the ability of			

individual Navy and Marine Corps units to fulfill their mission. A methodology that would identify homogeneous groups of patients with respect to convalescent leave would permit Navy Medical Department managers to monitor recommendations for convalescent leave by individual hospitals.

In this report, four patient grouping methods were compared for their ability to explain differences in convalescent leave among the active duty Navy and Marine Corps population. Three of the methods commonly used by the Navy to group patients are based on ICD9 diagnosis and surgery codes: (1) diagnosis categories, (2) diagnosis categories subdivided by surgery and complications, and (3) three digit diagnosis codes. The fourth method selected was the ICD9-CM Diagnosis Related Groups (DRGs). Results indicated that the DRGs performed only slightly better than three digit diagnosis codes (40.9 versus 40.1 percent explained variation) but required fewer groups in which to classify the active duty population. Therefore, DRGs were selected as the preferred grouping method to be used for comparing recommendations for convalescent leave across hospitals. *

Finally, since DRGs were developed to account for variances in length of stay, suggestions were made for modifying DRGs to make them more appropriate as a grouping method for explaining differences in convalescent leave among the active duty Navy and Marine Corps population. Recommendations included possibilities for recategorizing and collapsing current DRGs and for determining the impact of other variables such as patient occupation.

This research was sponsored by the Naval Medical Research and Development Command, Department of the Navy, under Research Work Unit M106-PN.001-0005. The views expressed in this report, however, are solely those of the authors. No endorsement by the Department of the Navy has been given or should be inferred.

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Using Diagnosis Related Groups (DRGs) to Monitor Convalescent Leave

Terrence L. Kay

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A primary responsibility of the Navy Medical Department is to ensure that active duty Navy and Marine Corps personnel who have experienced disease and injury are returned to duty as soon as medically indicated. One major contributor to lost work time among active duty personnel is convalescent leave, which is a period of medically ordered convalescence following hospitalization. Recommendations for convalescent leave that are not medically justifiable can have a serious impact on the ability of individual Navy and Marine Corps units to fulfill their mission. A methodology that would identify homogeneous groups of patients with respect to convalescent leave would permit Navy Medical Department managers to monitor recommendations for convalescent leave by individual hospitals. Hospitals that recommend relatively more convalescent leave for a selected medical condition than their peer hospitals could be identified and a medical audit conducted to determine if the leave recommended was either excessive or medically necessary.

The purpose of this report is to compare the ability of several alternative patient grouping methods to account for differences in convalescent leave among active duty Navy and Marine Corps personnel. For the ten major causes of lost work time due to convalescent leave, an estimate will be made of the potential savings that could result by reducing excess convalescent leave days. Finally, other factors that may account for differences in convalescent leave will be discussed.

Patient Grouping Strategies

Four alternative patient grouping strategies will be considered in this report, three of which are based on the International Classification of Diseases (ICD-9) coding scheme and are methods normally used by the Navy to classify patients. These three methods are: (1) diagnosis categories, (2) diagnosis categories further divided by surgery and complications, and (3) three digit diagnosis codes. The fourth grouping method is Diagnosis Related Groups (DRGs)¹, a patient grouping strategy developed by Yale University (under contract to the U.S. Health Care Financing Administration) to account for differences in average length of patient stay and patient charges. The assumption for using DRGs as a method to explain differences in convalescent leave is that patient groupings based on DRGs may also be homogeneous with respect to convalescent leave. To use DRGs for this purpose, it is not necessary that convalescent leave be related to average length of stay; it is only necessary that patients within a DRG tend to have the same amount of convalescent leave. For example, DRG 373 (Vaginal delivery without complicating diagnoses) contains active duty females who tend to have a relatively short length of stay (approximately four days) but a relatively long length of convalescence (approximately 30 days). In this instance it may be possible for this DRG to explain variances in both convalescent leave and length of stay.

Methodology and Procedures

Dependent Variable

At least three dependent variables can be used to compare convalescent leave across hospitals. They are: (1) average convalescent leave for active duty Navy and Marine Corps personnel who were recommended for convalescent leave, (2) average convalescent leave for all active duty Navy and Marine Corps dispositions, and (3) the proportion of active duty Navy and Marine Corps personnel who were recommended for convalescent leave. For this report, attention was focused on the first of these three dependent variables--average convalescent leave for those who were granted convalescent leave.

Source of Data

All patient data for this study are contained in the Inpatient Data System for Calendar Year 1980 and were obtained from the Naval Medical Data Services Center, Bethesda, Maryland.

Records Selected for Study

There were a total of 18,523 active duty Navy and Marine Corps dispositions during Calendar Year 1980 for which convalescent leave was recommended. Of this total, 2,804 dispositions were excluded because complete data were not available at the time each disposition record was assigned to a DRG and because certain diagnosis and surgery codes used by the Navy were not compatible with the codes used by the developers of the DRGs. Therefore, 15,719 or 85 percent of the active duty Navy and Marine Corps dispositions at naval hospitals that were

recommended for convalescent leave during 1980 were included in this analysis.

Conversion of ICD9 Diagnosis Codes and ICPM Surgery Codes to ICD9-CM

Naval hospitals code their patient records using International Classification of Diseases, Ninth Revision (ICD-9)² diagnosis codes and International Classification of Procedures in Medicine (ICPM)³ surgery codes. In contrast, DRGs were developed using a clinical modification to the ICD9 and ICPM codes which provided more precise codes for describing a patient's clinical picture, the ICD-9CM (clinical modification)⁴. There is no major problem with compatibility of diagnosis codes between these two methods since ICD9 diagnosis codes can generally be assigned to an ICD9-CM code. The surgical codes used by the two systems, however, are very different. Therefore, the Research Department at the Naval School of Health Sciences completed a preliminary edit that replaced each ICPM surgery code with an appropriate ICD9-CM code. This procedure was not designed to provide an exact mapping between the two systems but was done to ensure that patient records were assigned to the correct DRG. Not all ICD9 diagnosis codes and ICPM surgical codes can be precisely assigned to an ICD9-CM DRG. For example, many of the DRGs included in Major Diagnostic Category 22--Burns--require more detail than is contained in the diagnosis codes.

Hypotheses and Statistical Techniques

The main hypothesis to be tested was that the amount of variation in convalescent leave accounted for by DRGs was significantly greater

than that accounted for by groupings based on ICD9 diagnosis codes: diagnosis categories, three digit diagnosis codes, and a third grouping based on subdividing diagnosis categories into four groups depending on whether surgery was required or complications were present. The method selected to test this hypothesis is commonly referred to as a partial F-test using the extra sums of squares principle⁵. This technique is used for analysis of variance and regression problems to determine if the additional variance accounted for by adding a variable to a model is statistically significant. Because of the large number of records and patient groupings involved, the partial F-test results were only approximated. That is, given the variation that had already been accounted for by one of the other methods, the minimum amount of additional variation that would be accounted for by using DRGs was calculated. Caution should be used in interpreting these results since very small increases in explained variation may appear significant because of the large number of records included in this analysis. To partially compensate for this problem, an additional criteria was included--the F ratio should have a probability level of $p < .001$ for an increase in explained variance to be considered statistically significant.

Results

Comparison of Patient Grouping Methods

The greatest amount of variation in convalescent leave--40.9 percent--was accounted for by grouping patients according to the DRG methodology (Table 1). Using a partial F-test, the variance explained

TABLE 1

PERCENTAGE OF VARIATION IN RECOMMENDED CONVALESCENT LEAVE DAYS
ACCOUNTED FOR BY SELECTED PATIENT GROUPING METHODS FOR ACTIVE DUTY NAVY AND
MARINE CORPS PERSONNEL, CY 1980

Patient Grouping Method	Number of Groups	Explained Variation (Percent)
Diagnosis Category	112	28.4
Diagnosis Category Subdivided by Surgery and Complications	376	36.4
Three Digit Diagnosis Code	634	40.1
Diagnosis Related Groups	350	40.9

by DRGs was significantly greater than that accounted for by diagnosis category and by diagnosis category when subdivided by surgery and complications. Although DRGs accounted for a slightly higher percentage of the variance than three digit diagnosis codes (40.9% vs. 40.1%), this difference was not statistically significant. However, DRGs were able to explain this slightly higher variance by dividing the population into fewer groups (350 groups for DRGs vs. 634 groups for three digit diagnosis code). This lower number of groups is desirable because it is much easier for a manager to monitor fewer patient groupings. Therefore, DRGs were selected as the preferred patient grouping method; they will be used in the remainder of this report to estimate the potential savings in lost work time that could result by reducing convalescent leave days for those hospitals that exceed the average amount recommended by all naval facilities. (See Appendix Tables 1-3 for details of the tests of statistical significance).

Reducing Excess Convalescent Leave

DRGs With the Greatest Potential for Savings in CL

The greatest reduction in excess convalescent leave days would likely result from monitoring leave for those medical conditions that (1) generated the most convalescent leave days and (2) varied extensively among hospitals. Table 2 lists the ten DRGs that generated the most convalescent leave days during Calendar Year 1980. The average number of convalescent leave days granted to patients for these conditions is listed in Table 3. The standard deviations

TABLE 2

CONVALESCENT LEAVE DAYS FOR THE TEN DRGs THAT
GENERATED THE MOST CONVALESCENT LEAVE DAYS,
ACTIVE DUTY NAVY AND MARINE CORPS PERSONNEL, 1980*

Rank	DRG Number	Rubric	Convalescent Leave Days	Percent of Total
	Total		243,777	100.0
1	373	Vaginal delivery without complicating diagnosis	23,661	9.7
2	162	Inguinal and femoral hernia procedures age 18-69 (without complications/comorbidity)	14,586	6.0
3	234	Miscellaneous musculoskeletal procedures	14,112	5.8
4	254	Fractures, sprains, etc. of upper arm or lower leg	9,095	3.7
5	243	Medical back problems	9,030	3.7
6	56	Rhinoplasty	7,388	3.0
7	167	Appendectomy without complicated principal diagnosis (without complications or comorbidity)	6,273	2.6
8	231	Local excision and removal of internal fixtured devices except hip and femur	5,683	2.3
9	160	Hernia except inguinal and femoral (without complications or comorbidity)	5,349	2.2
10	339	Testes procedures, non-malignant age > = 18	4,585	1.9
	Top 10 DRGs--total		99,762	40.9
	All other DRGs		144,015	59.1

* Excludes dispositions not able to be assigned to a DRG.

TABLE 3

AVERAGE NUMBER OF CONVALESCENT LEAVE DAYS AND STANDARD DEVIATIONS,
FOR THE TEN DRGs THAT GENERATED THE MOST CONVALESCENT LEAVE,
ACTIVE DUTY NAVY AND MARINE CORPS PERSONNEL, 1980

Rank	DRG Number	Rubric	Number of Convalescent Leave Days	Number of Dispositions	Average Number of Convalescent Leave Days	Standard Deviation
1	373	Vaginal delivery without complicating diagnosis	23,661	796	29.7	2.6
2	162	Inguinal and femoral hernia procedures, age 18-69 (without complications/ comorbidity)	14,586	866	16.8	6.3
3	234	Miscellaneous musculoskeletal procedures	14,112	727	19.4	8.8
4	254	Fractures, sprains, etc. of upper arm or lower leg	9,095	500	18.2	8.8
5	243	Medical back problems	9,030	563	16.0	9.3
6	56	Rhinoplasty	7,388	816	9.0	5.0
7	167	Appendectomy without complicated principal diagnosis (without complications or comorbidity)	6,273	403	15.6	5.9
8	231	Local excision and removal of internal fixture devices except hip and femur	5,683	345	16.5	8.4
9	160	Hernia except inguinal and femoral (without complications or comorbidity)	5,349	341	15.7	6.4
10	339	Testes procedures, non- malignant, age >= 18	4,585	374	12.3	6.2

included show to what extent convalescent leave varies within a specific DRG. In general, the larger the standard deviation relative to the mean, the greater will be the potential savings in lost work time if convalescent leave days are monitored. For example, the leading cause of convalescent leave was DRG 373--Vaginal delivery without complicating diagnoses--and the second leading cause was DRG 162--Inguinal and femoral hernia procedures, age 18-69 without complications or comorbidity. The leading cause had a relatively small standard deviation in comparison to the mean (mean = 29.7 days, standard deviation = 2.6) while the standard deviation for the second leading cause was relatively larger (mean = 16.8 days, standard deviation = 6.3). As expected, convalescent leave varied among hospitals to a greater extent for hernias (DRG 162) than for deliveries (DRG 373). These results indicate the potential for greater manpower savings by monitoring convalescent leave for hernias than for deliveries.

Excess Convalescent Leave by Facility

A mechanism for reducing convalescent leave days is to analyze the convalescent leave practices of those hospitals granting more leave than others. For the purposes of this report, we have defined excess convalescent leave days as the number of days that exceeds the expected recommendation, given the number of dispositions within the selected DRG at a specific hospital and the average number of convalescent leave (CL) days granted by all facilities for that DRG.

That is, for a selected DRG and hospital:

$$\begin{array}{ccccc} \text{excess convalescent} & = & \text{actual total} & - & \text{expected total} \\ \text{days} & & \text{CL days} & & \text{CL days} \end{array}$$

where: $\begin{array}{ccccc} \text{expected total} & = & \text{number of dispositions} & \times & \text{average CL days} \\ \text{CL days} & & \text{at selected facility} & & \text{at all facilities.} \end{array}$

Other Factors that May Account for Variation in Convalescent Leave

To develop a patient grouping method based on DRGs that would optimally account for differences in convalescence leave among active duty Navy and Marine Corps personnel, one should consider at least two approaches. The first strategy is to recategorize variables used by the DRGs developers into groups that are more appropriate to the active duty population. For example, age is usually divided into three subgroups, 0-17, 18-69, and 70 or over. To account for length of convalescent leave, one may need different age groupings such as ages 17-19, 20-25, 26-40, etc. Certain DRGs may also be combined, thus reducing the total number of groups needed to account for differences in convalescent leave. For example, DRGs 159-162 are used to group patients over age 17 who required surgical repair of a hernia. As seen in Table 4, there is very little difference in convalescent leave among these DRGs which suggests that they could be collapsed into one group.

The second approach to modifying DRGs to more fully account for convalescent leave would be to determine the impact of other variables

TABLE 4
CONVALESCENT LEAVE FOLLOWING HERNIA SURGERY,
ACTIVE DUTY NAVY AND MARINE CORPS PERSONNEL, 1980

DRG Number	Rubric	Dispositions	Mean	Standard Deviation
159	Hernia procedures except inguinal femoral, with complications or comorbidity or age > 69	9	17.3	10.9
160	Hernia procedures except inguinal and femoral, age 18-69, without complications or comorbidity	341	15.7	6.4
161	Inguinal and femoral hernia procedures with complications or comorbidity or age > 69	12	16.7	7.3
162	Inguinal and femoral hernia procedures age 18-69, without complications or comorbidity	866	16.8	6.3

not currently addressed by the DRG grouping method. Potentially important variables which may affect the amount of convalescent leave one receives are occupation, duty station, whether the patient was treated for a occupationally related disease or injury, and whether the hospital that treated the patient contains a medical holding company. These and other variables such as officer-enlisted status and pay grade should be analyzed to determine their effect on recommendations for convalescent leave by physicians at naval hospitals.

Summary

In this report we compared four patient grouping methods for their ability to explain differences in convalescent leave among the active duty Navy and Marine Corps population. Three of the methods commonly used by the Navy to group patients are based on ICD9 diagnosis and surgery codes: (1) diagnosis categories, (2) diagnosis categories subdivided by surgery and complications, and (3) three digit diagnosis codes. The fourth method selected was the ICD9-CM Diagnosis Related Groups (DRGs). Results indicated that the DRGs explained 40.9 percent of the variation in convalescent leave, which was a statistically greater amount of variation than explained by diagnosis categories (28.4 percent) and diagnosis categories when subdivided by surgery and complications (36.4 percent). DRGs performed only slightly better than three digit diagnosis codes (40.1 percent explained variation) but required fewer groups in which to classify the active duty population. Therefore, DRGs were selected as

the preferred grouping method to be used for comparing recommendations for convalescent leave across hospitals.

Finally, since DRGs were developed to account for variances in length of stay, suggestions were made for modifying DRGs to make them more appropriate as a grouping method for explaining differences in convalescent leave among the active duty Navy and Marine Corps population. Recommendations included possibilities for recategorizing and collapsing current DRGs and for determining the impact of other variables such as patient occupation.

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APPENDIX TABLE 1

MINIMUM ADDITIONAL VARIATION IN CONVALESCENT LEAVE EXPLAINED BY
DRG: AFTER ACCOUNTING FOR VARIATION EXPLAINED BY
DIAGNOSIS CATEGORY

Source	Degrees of Freedom	Sums of Squares	Mean Square	F Value	Probability Level	Explained Variation (Percent)
Diagnosis Category	111	392356.8	3534.7	66.2	p < .001	28.4
DRG	349	172815.8	495.2	9.3	p < .001	12.5
Error	15258	815506.0	53.4			
Total	15718	1380678.6				

APPENDIX TABLE 2

MINIMUM ADDITIONAL VARIATION IN CONVALESCENT LEAVE
EXPLAINED BY DRGs AFTER ACCOUNTING FOR VARIATION
EXPLAINED BY DIAGNOSIS CATEGORY SUBDIVIDED BY
SURGERY AND COMPLICATIONS

Source	Degrees of Freedom	Sums of Squares	Mean Square	F Value	Probability Level	Explained Variation (Percent)
Diagnosis Category Subdivided by Surgery/Complications	375	502644.5	1340.4	24.6	p < .001	36.4
DRG	349	62528.2	179.2	3.3	p < .001	4.5
Error	14994	815506.1	54.4			
Total	15718	1380678.6				

APPENDIX TABLE 3

MINIMUM ADDITIONAL VARIATION IN CONVALESCENT LEAVE
EXPLAINED BY DRGs AFTER ACCOUNTING FOR VARIATION
EXPLAINED BY THREE DIGIT DIAGNOSIS CODE

Source	Degrees of Freedom	Sums of Squares	Mean Square	F Value	Probability Level	Explained Variation (Percent)
Three Digit Diagnosis Code	633	553377.9	874.2	15.8	$p < .001$	40.1
DRG	349	11794.7	33.8	0.6	$p > .1$	0.8
Error	14736	815506.1	55.3			
Total	15718	1380678.6				

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